Prepared in cooperation with the
CAPITAL AREA GROUND WATER
CONSERVATION COMMISSION

Griffith, J.M., and Lovelace, J.K., 2003, Louisiana ground-water map no. 16:
Potentiometric surface of the "1,500-foot" sand of the Baton Rouge area, Louisiana, spring 2001

INTRODUCTION

The "1,500-foot" sand of the Baton Rouge area is a major source of fresh ground water in a five-parish area which includes East and West Baton Rouge, East and West Feliciana, and Pointe Coupee Parishes (hereinafter referred to as the Baton Rouge area) in southeastern Louisiana (fig. 1). In 2001, the "1,500-foot" sand was the fifth most heavily pumped aquifer of the 14 aquifers (fig. 2) underlying this area. In 2001, about 17.8 Mgal/d was withdrawn from the "1,500-foot" sand in the Baton Rouge area (fig. 3). Of this amount, about 85 percent was used for public supply and about 15 percent for industrial purposes (D.C. Dial, Capital Area Ground Water Conservation Commission, written commun., 2002). Most of the water, about 14.5 Mgal/d, was withdrawn in East Baton Rouge Parish (D.C. Dial, Capital Area Ground Water Conservation Commission, written commun., 2002). From 1990 to 2001, withdrawals from the "1,500-foot" sand decreased by about 9 percent (from about 19.5 to 17.8 Mgal/d, fig. 3) in the Baton Rouge area.

Pumpage from the "1,500-foot" sand has caused water-level declines in the Baton Rouge area (Meyer and Turcan, 1955, p. 54-57). Also, previous studies have shown that saltwater[1] encroachment (horizontal movement) into freshwater areas has occurred in response to pumpage (Tomaszewski, 1996, p. 6; Whiteman, 1979, p. 29-35).

Additional knowledge about ground-water flow and effects of withdrawals on the "1,500-foot" sand of the Baton Rouge area is needed to assess ground-water-development potential and to protect the resource. To meet this need, the U.S. Geological Survey (USGS), in cooperation with the Capital Area Ground Water Conservation Commission (CAGWCC), began a study in 2000 to measure and document the current (2001) water levels in wells screened in the "1,500-foot" sand, construct a potentiometric-surface (water-levels) map, and to evaluate changes in the potentiometric surface.

This report presents data and maps that describe the potentiometric surface of the "1,500-foot" sand of the Baton Rouge area during the spring of 2001. Graphs of water levels in selected wells and water withdrawals from the "1,500-foot" sand are presented to show the historical changes in water levels and water use. The potentiometric-surface map illustrates the water levels and ground-water flow directions in the aquifer for spring 2001. Water-level and water-use data are on file at the USGS and CAGWCC offices in Baton Rouge, Louisiana.

Description of Study Area

The study area (fig. 1) extends across about 2,000 mi^2 and includes East and West Baton Rouge, East and West Feliciana, and Pointe Coupee Parishes (Calhoun and Frois, 1997, p. 153). The City of Baton Rouge and several industrial facilities are located in the study area along the Mississippi River. The climate is generally warm and temperate with high humidity and frequent rain. At Baton Rouge, the average annual temperature is 68ºF, and the average annual rainfall is about 60 in. (National Oceanic and Atmospheric Administration, 1995, p. 5, 8). With the exception of the Baton Rouge metropolitan area, much of the study area is rural and agricultural.

Hydrogeologic Setting

Beneath the study area is a sequence of complexly interbedded, interconnected, lenticular, alluvial, freshwater-bearing, sandy, and graveliferous strata that form a wedge of sediment that dips and thickens in a south-to-southwest direction. Fourteen freshwater aquifers (fig. 2) in the area are composed of sediment that can contain very fine to coarse sand and pea- to cobble-size gravel (Meyer and Turcan, 1955, p. 21-47). Thirteen of the aquifers were originally named according to their general depth in the Baton Rouge industrial district (Meyer and Turcan, 1955, p. 12-13). A prominent hydrogeologic feature in the region is the Baton Rouge fault (fig. 1) which extends from east of the study area through East and West Baton Rouge Parishes to west of the study area (Durham and Peeples, 1956; Murray, 1961, p. 189-190; Whiteman, 1979, pl. 6; McCulloh, 1991).

Precipitation in the northern part of the study area and north of the study area in Mississippi is the primary source of recharge of freshwater to the "1,500-foot" sand. Because the aquifers in the region are interconnected, some infiltrated precipitation percolates down into and through the surficial aquifers in the recharge area to deeper interconnected aquifers, which include the "1,500-foot" sand (Morgan, 1963, p. 11-13). Generally, water continues to move downdip in a southerly direction through the aquifer toward the Baton Rouge fault at rates that range from a few tens of feet per year to several hundreds of feet per year (Buono, 1983, p. 24). The southern limit of freshwater in the "1,500-foot" sand generally is considered to be at or near the Baton Rouge fault (Tomaszewski, 1996, p. 6).

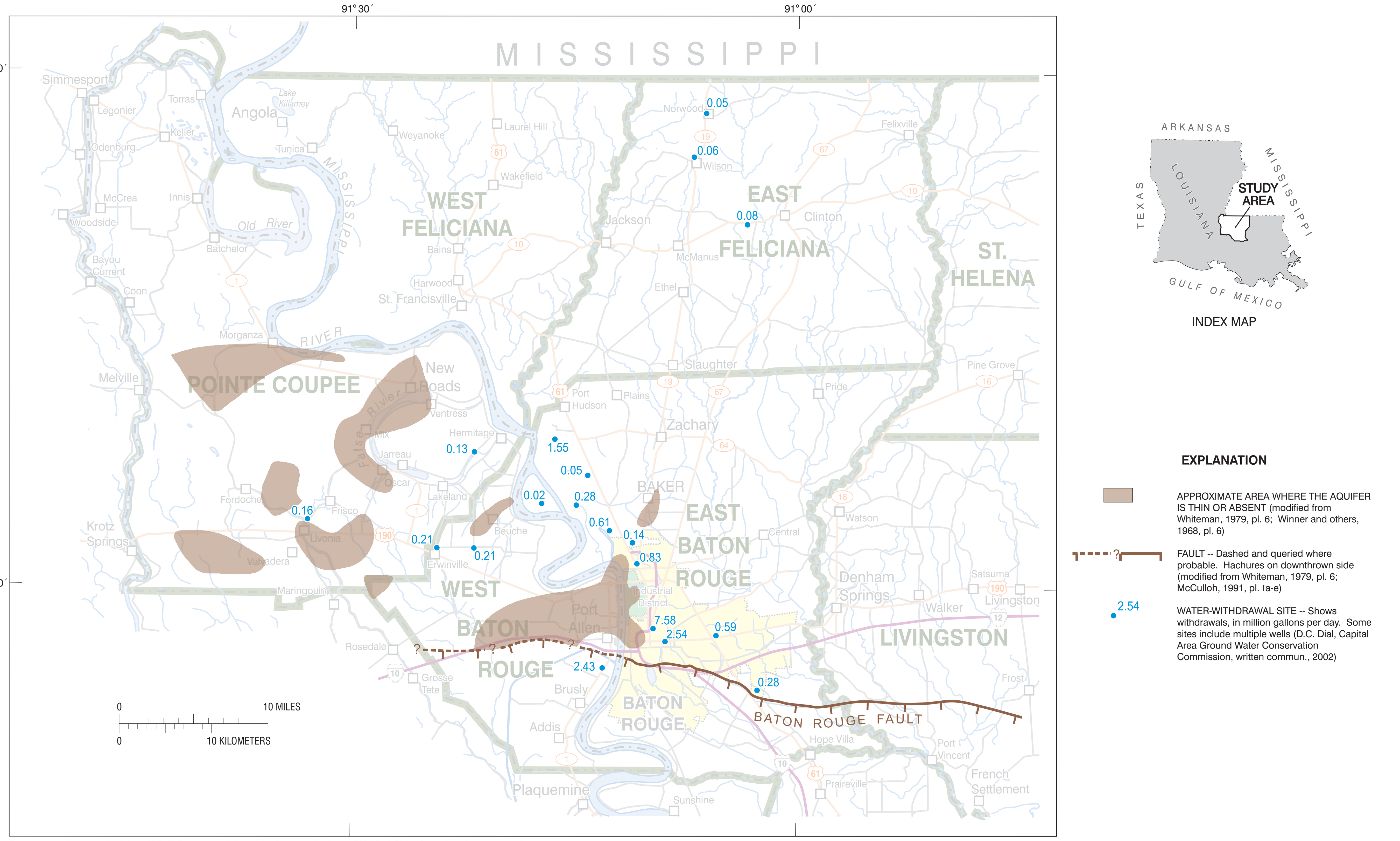
Development of the "1,500-foot" sand began after 1927 (Torak and Whiteman, 1982, table 4). From 1940 to 2001 water levels declined about 160 ft at well EB-168 (fig. 3). Well EB-168 is located near pumping centers in the Baton Rouge southeast of the industrial district (fig. 4). However, from 1951 to 2001 water levels at well PC-39 changed less than 27 ft (fig. 3). Although both wells are screened in the "1,500-foot" sand, well PC-39 is located near the recharge area and where little or no water withdrawals occur.

Before development, water entered the "1,500-foot" sand in the recharge area, and flowed generally in a south to southwest direction to the discharge area near the Baton Rouge fault (Meyer and Turcan, 1955, p. 51; Morgan, 1963, p.13; Huntzinger and others, 1985, p. 8). At the discharge area, the Baton Rouge fault can act as a leaky barrier to horizontal ground-water flow (Whiteman, 1979, p. 12, 13). Also, water from the recharge area would move upward (probably along the fault) from the "1,700-foot" sand into the "1,500-foot" sand and from the "1,500-foot" sand into the "1,200-foot" sand due to vertical head[2] differences at the discharge area (Meyer and Turcan, 1955, p. 51; Morgan, 1963, p. 13; Huntzinger and others, 1985, p. 8). Recently, however, water withdrawals in the study area have caused water to flow toward pumping centers and reduced the vertical head gradient in what was the discharge area near the fault, and the upward movement of water has diminished (Meyer and Turcan, 1955, p. 51; Morgan, 1963, p.13).

Large water withdrawals north of the fault might have induced saltwater encroachment from south of the fault toward pumping centers north of the fault where the "1,500-foot" sand previously contained freshwater. Tomaszewski (1996, p. 9) showed that saltwater was present in the "1500-foot" sand north of the Baton Rouge fault in a 1.5-mi^2 area in the vicinity of Acadian Thruway in Baton Rouge. In 1998, in an effort to mitigate saltwater encroachment in the aquifer, the CAGWCC installed a "connector well" between municipal supply wells and the freshwater-saltwater interface in the "1500-foot" sand. The "connector well," EB-1293, is screened in both the "800-foot" and "1,500-foot" sands. At well EB-1293, the water level in the "800-foot" sand is higher than the water level in the "1,500-foot" sand, and subsequently, 0.6 to 0.7 Mgal/d of water continously flows through the well from the "800-foot" sand to the "1,500-foot" sand (Capital Area Ground Water Conservation Commision, 2002). Flow into the "1,500-foot" sand is expected to raise the potentiometric surface near well EB-1293 and deflect the advance of the saltwater away from the municipal supply wells.

[1]Saltwater in this report is defined as water that contains chloride at concentrations of more than 250 mg/L; concentrations of chloride less than 250 mg/L are within the secondary maximum contaminant level (SMCL's are established for contaminants that can adersely affect the aesthetic quality of drinking water) of the secondary drinking water regulations. At high concentrations or values, health implications as well as aesthetic degradation might exist. SMCL's are not federally enforceable, but are intended as guidelines for the states (U.S. Environmental Protection Agency, 1977, 1992).

[2]The altitude to which water rises (in a well) at a given point as a result of reservoir pressure (Bates and Jackson, 1984, p. 231).



Base map modified from Louisiana Oil Spill Coordinator, Office of the Governor, Louisiana GIS CD: A Digital Map of the State, Version 2.0

Figure 1. Water withdrawals from the "1,500-foot" sand and location of the study area in the Baton Rouge area, southeastern Louisiana, 2001.

System	Series	Stratigraphic unit	Aquifer[3] or confining unit
Quaternary	Holocene	Mississippi River and other alluvial deosits	Mississippi River alluvial aquifer
Quaternary	? Pleistocene	Unnamed Pleistocene deposits	Shallow sands
Quaternary	Pleistocene	Unnamed Pleistocene deposits	Upland terrace aquifer: "400-foot" sand
Quaternary	Pleistocene	Unnamed Pleistocene deposits	Upland terrace aquifer: "600-foot" sand
Tertiary	Pliocene	Fleming Formation: Blounts Creek Member	"800-foot" sand
Tertiary	Pliocene	Fleming Formation: Blounts Creek Member	"1,000-foot" sand
Tertiary	Pliocene	Fleming Formation: Blounts Creek Member	"1,200-foot" sand
Tertiary	?	Fleming Formation: Blounts Creek Member	"1,500-foot" sand
Tertiary	Miocene	Fleming Formation: Blounts Creek Member	"1,700-foot" sand
Tertiary	Miocene	Fleming Formation: Castor Creek Member	Unnamed confining unit
Tertiary	Miocene	Fleming Formation: Williamson Creek Member	"2,000-foot" sand
Tertiary	Miocene	Fleming Formation: Dough Hills Member	"2,400-foot" sand
Tertiary	Miocene	Fleming Formation: Carnahan Bayou Member	"2,800-foot" sand
Tertiary	Miocene	Fleming Formation: Lena Member	Unnamed confining unit
Tertiary	? Oligocene	Catahoula Formation	Catahoula aquifer

[3]Clay units separating aquifers in the Baton Rouge area are discontinuous and unnamed.

Figure 2. Hydrogeologic units in the Baton Rouge area, southeastern Louisiana (modified from Stuart and others, 1994, fig. 5; Lovelace and Lovelace, 1995, fig. 1).

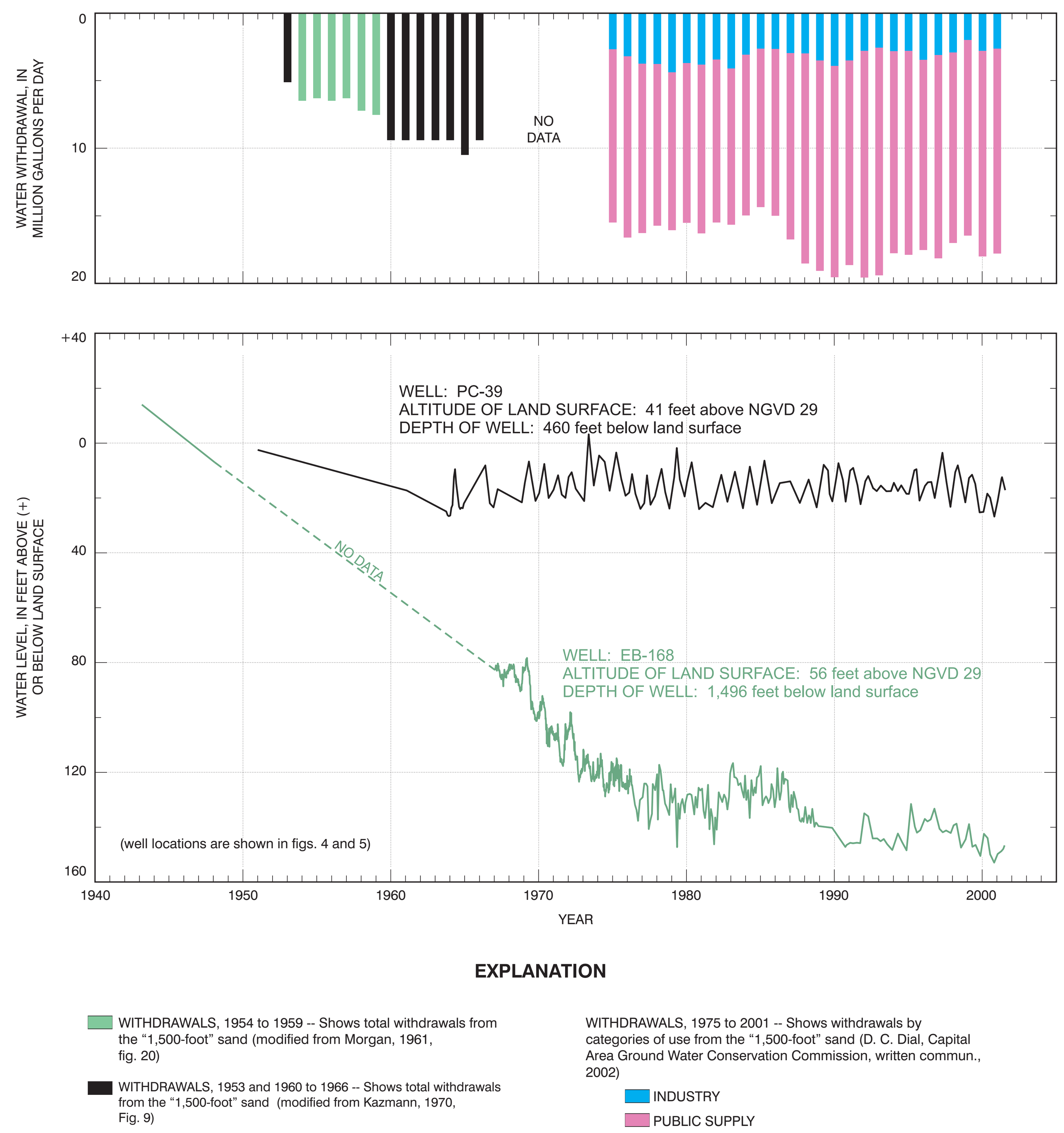


Figure 3. Water withdrawals from the "1,500-foot" sand and water levels in wells EB-168 and PC-39 in the Baton Rouge area, southeastern Louisiana.

CONVERSION FACTORS, DATUMS, AND ABBREVIATED WATER-QUALITY UNIT

Multiply	By	To obtain
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
foot per year (ft/yr)	0.3048	meter per year (m/yr)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
gallons per minute (gal/min)	0.06309	liter per second (L/s)
million gallons per day (Mgal/d)	3,785	cubic meter per day (m^3/d)

Temperature in degrees Fahrenheit (°F) can be converted to degrees Celsius (°C) as follows: °C = (°F - 32)/1.8.

Vertical coordinate information in this report is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Horizontal coordinate information in this report is referenced to the North American Datum of 1927.

Abbreviated water-quality unit:
milligrams per liter (mg/L)

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POTENTIOMETRIC SURFACE

Potentiometric-surface maps (figs. 4, 5) were constructed using water-level data from 21 wells completed in the "1,500-foot" sand (table 1). Water levels primarily were measured during April and May 2001; one measurement was made during July 2001. Water levels were measured using steel or electrical tapes marked with 0.01-ft gradations. Wells in which water levels were measured were not being pumped at the time the measurements were made. If wells recently were pumped, water levels were measured after an appropriate recovery period. Water levels were not measured south of the Baton Rouge fault where the aquifer is offset and hydraulically separated from its equivalent unit north of the fault. Also, flow in well EB-1293 is continuous; therefore, the water level in the well probably is not representative of the water level in the "1,500-foot" sand near the well and was not used to construct the potentiometric surface shown in figures 4 and 5.

The highest water level, 123.48 ft above NGVD 29, was measured at well EF-210 in northern East Feliciana Parish (table 1). The lowest water level, 135.23 ft below NGVD 29, was measured at well EB-657 in Baton Rouge (table 1, fig. 5). Water levels were more than 70 ft below NGVD 29 in most of the Baton Rouge metropolitan area. A small cone of depression about 60 ft below NGVD 29 was noted in the vicinity of well EB-963 in northwestern East Baton Rouge Parish (fig. 4). Another small cone of depression about 100 ft below NGVD 29 was noted at well EB-413. The cones and other potentiometric lows were in areas where large ground-water withdrawals occurred. A comparison between the 1990 (Tomaszewski, 1996, fig. 9) and the 2001 potentiometric-surface maps of the "1,500-foot" sand indicates water levels in the Baton Rouge metropolitan area have declined by 10 ft to 20 ft during the 11-year period.

In spring 2001, the flow of water in the "1,500-foot" sand in the Baton Rouge area generally was down gradient from the recharge area toward pumping centers along the Mississippi River and in Baton Rouge (figs. 1, 4, 5). In East and West Feliciana and East Baton Rouge Parishes, flow generally was south to southwest toward areas of large withdrawals in East Baton Rouge Parish along the Mississippi River between wells EB-963 and EB-413. Ground-water flow in Baton Rouge (fig. 5) was toward the vicinity of well EB-657 where the average water-withdrawal rate was 5.74 Mgal/d in 2001 . Because the "1,500-foot" sand is offset at the Baton Rouge fault (Whiteman, 1979, p.12-13), withdrawals south of the fault have little effect on the potentiometric surface north of the fault .

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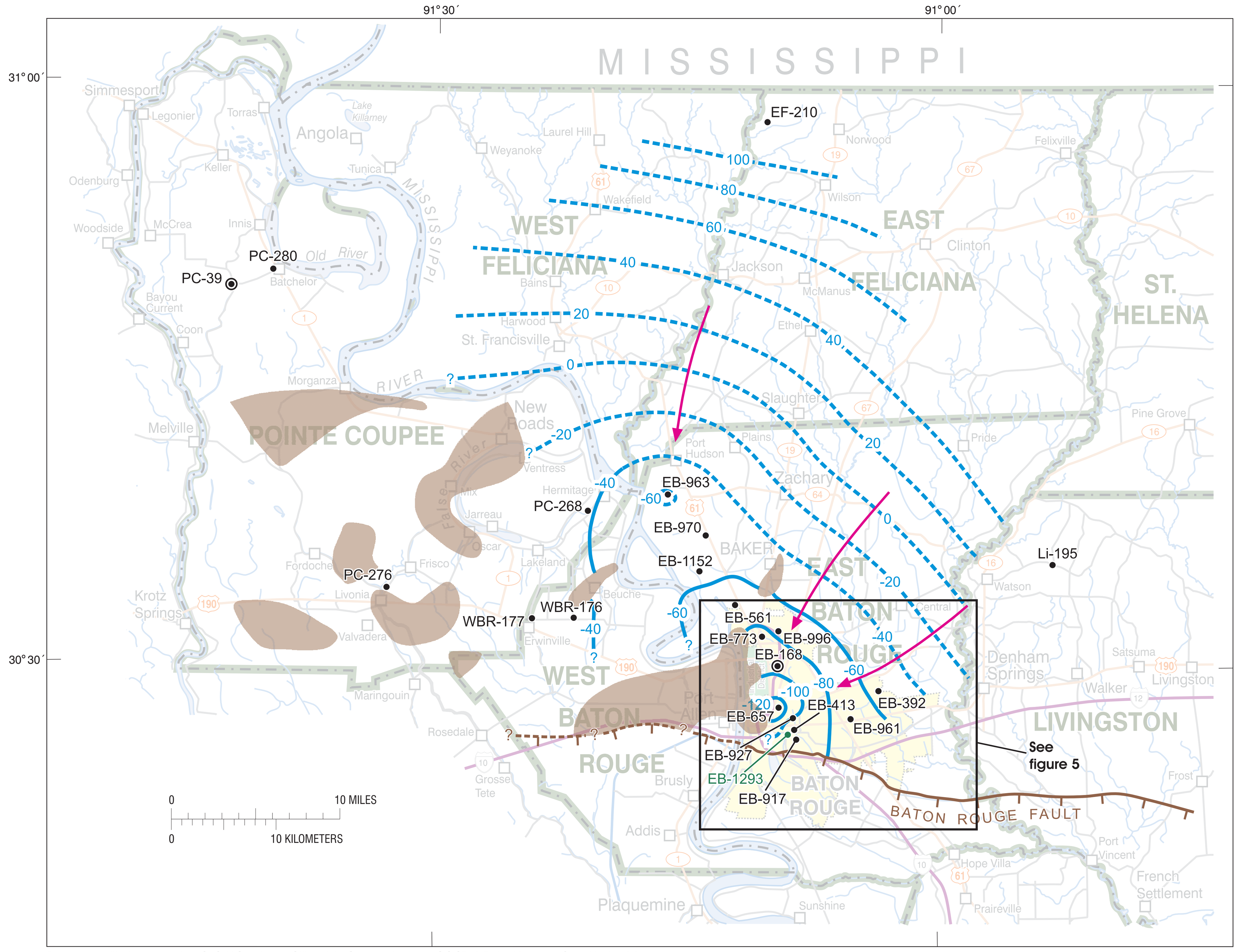


INDEX MAP

EXPLANATION

(Explanation also refers to fig. 5)

APPROXIMATE AREA WHERE THE AQUIFER IS THIN OR ABSENT (modified from Whiteman, 1979, pl. 6; Winner and others, 1968, pl. 6)

FAULT -- Dashed and queried where probable. Hachures on downthrown side (modified from Whiteman, 1979, pl. 6; McCulloh, 1991, pl. Ia-e)

20 — POTENTIOMETRIC CONTOUR -- Shows altitude at which water level would have stood in tightly cased wells. Dashed where approximately located. Contour interval 10 and 20 feet. Vertical datum is NGVD 29

FLOW ARROW -- Shows general direction of ground-water flow

EB-961 CONTROL POINT -- Shows location and number of well used for contouring potentiometric surface (see table 1 for water-level data)

EB-168 WELL WITH HYDROGRAPH -- Shows location and number of well for which a hydrograph is shown (see fig. 3 for hydrograph)

EB-1293 CONNECTOR WELL -- Shows location of well screened in both the "800-foot" and "1,500-foot" sands

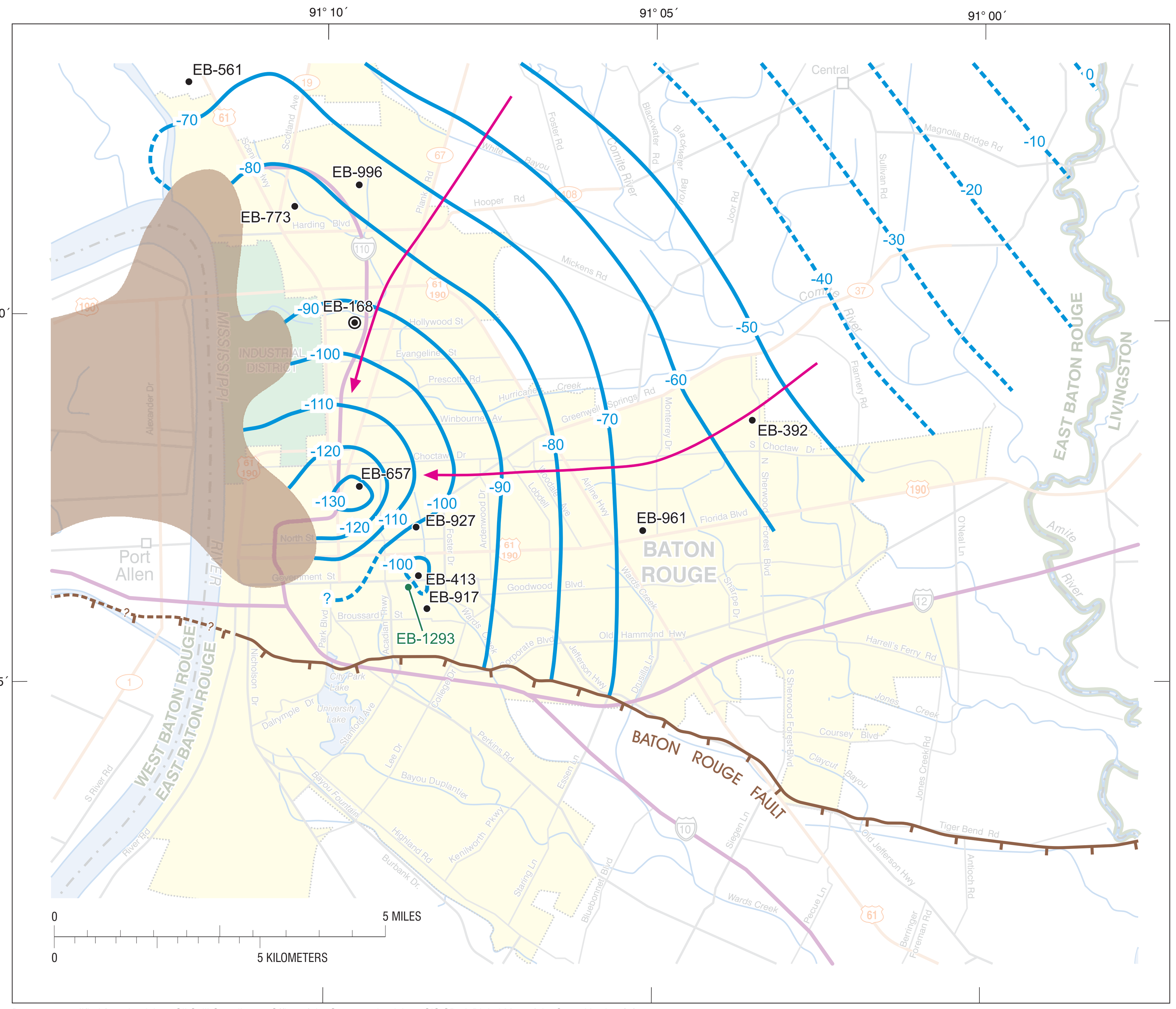
Base map modified from Louisiana Oil Spill Coordinator, Office of the Governor, Louisiana GIS CD: A Digital Map of the State, Version 2.0

Figure 4. Potentiometric surface of the "1,500-foot" sand in the Baton Rouge area, southeastern Louisiana, spring 2001.

Table 1. Water-level data used to construct the potentiometric-surface map of the "1,500-foot" sand in the Baton Rouge area, southeastern Louisiana, spring 2001
[Well locations and numbers are shown in figures 4 and 5.]

Well number	Altitude of land surface, in feet above NGVD 29	Date measured	Water level, in feet above (+) or below (-) NGVD 29
East Baton Rouge Parish			
EB-168	56.00	4-17-01	-92.77
EB-392	50.00	4-9-01	-56.04
EB-413	49.00	4-19-01	-102.70
EB-561	71.50	5-1-01	-64.17
EB-657	59.00	4-19-01	-135.23
EB-773	57.00	4-25-01	-88.27
EB-917	46.56	4-15-01	-99.24
EB-927	47.00	4-25-01	-99.22
EB-961	50.00	4-19-01	-67.00
EB-963	80.00	4-30-01	-61.42
EB-970	82.00	5-17-01	-48.79
EB-996	60.00	7-6-01	-73.87
EB-1152	79.00	4-27-01	-56.54
[1]EB-1293	45.00	4-20-01	-75.06
East Feliciana Parish			
EF-210	230.00	4-6-01	+123.48
Livingston Parish			
Li-195	73.00	5-1-01	+47.04
Pointe Coupee Parish			
PC-39	41.00	4-24-01	+28.06
PC-268	36.00	4-10-01	-39.96
PC-276	25.00	4-23-01	-55.73
PC-280	42.00	4-11-01	+24.71
West Baton Rouge Parish			
WBR-176	20.00	4-23-01	-36.89
WBR-177	23.00	4-18-01	-33.96

[1]The water level in well EB-1293 was not used to construct the potentiometric-surface map.



Base map modified from Louisiana Oil Spill Coordinator, Office of the Governor, Louisiana GIS CD: A Digital Map of the State, Version 2.0

Figure 5. Potentiometric surface of the "1,500-foot" sand in parts of East and West Baton Rouge Parishes, southeastern Louisiana, spring 2001.

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